

The Australian Road Research Board 1960–88 —patterns and achievements

J. B. Metcalf

Dr Metcalf

Since the Paper was published five new items have emerged.

57. The first is the use of video technology for the unobtrusive observation of traffic. The innovation consists of a method of analysing the picture on a TV monitor by electronically detecting the changes in contrast between a point on the screen which is clear of the trafficked area and up to 15 points located in the paths of vehicles. The instrumentation³⁷ gives the time of any change in contrast, and a software package reduces this data to vehicle length, speed and time of passage.

58. Second, the outcome of studies of fuel consumption have emerged, as illustrated by Table 2.²⁵

59. Third, there is the advent of the CULWAY weight-in-motion system which uses strain gauge amplifiers mounted inside the box culvert which is commonly used for drainage in Australia. There is associated software to give distributions of vehicle gross and axle group masses, length and speeds.³⁸

60. Fourth, studies of articulated vehicle stability³⁹ have led to guidance for matching tractor-trailer units. It is expected that further research will initiate studies of in-cab warning devices, because the results showed that drivers can be unaware of incipient instability.

61. Fifth, and last, the ARRB has been reviewing the whole research strategy to bring the scope and priorities of the programme closer to the wider community

Table 2. *Estimated savings from changes in control*

Control change	Intersection conditions	Delay: veh-h	Fuel: L†
1	Priority to roundabout		
	Peak traffic	5.37	2.3
	Off-peak traffic	0.33	–4.6
	Minimum daily*	6.69	–16.1
2	Priority to VA signal		
	Peak traffic	3.34	4.5
	Off-peak traffic	–0.41	–2.0
	Minimum daily*	1.70	–3.5

* A conservative minimum, based on: peak saving + (off-peak saving) × 4

† A negative value denotes a penalty

DISCUSSION

Table 3. Task oriented budget 1989–90

	Budget	
	%	\$ × 10 ³
Used		
Freight	7	511
Public and private transport	1	35
Managed		
Asset management	21	1142
Traffic	7	353
Safety	6	334
Enhanced		
Pavement surfacing and construction standards	10	526
Planning design and evaluation	6	308
Technology transfer		
Instrumentation services	26	1365
Information services	9	461
External services	7	386
(Total with management services distributed as overhead)	(100)	

of road users for whom the member authorities of the ARRB provide and operate the road infrastructure of Australia. This has led to a programme of research for 1989–90 budgetted at some A\$8 million. The programme is targetted to how the system is used, managed and enhanced with a major commitment to implementation of the research through a technology transfer effort expanded from previous years (Table 3).

Mr J. Porter, TRRL

My first question concerns funding of research at the ARRB. It was interesting to see that the ARRB has three balanced sources of income. It has an income from federal government, an income from local government and the states, and a third income from the private sector—from its ability to sell itself. In the UK the TRRL is an integral part of the Department of Transport and until recently almost all its research income had come from the Department. But the Department looks after only 5% of the roads in this country; the other 95% are the responsibility of the local authorities. Fortunately the TRRL works closely with local authorities, and local authorities do a good deal of research themselves, but all too often the results are not sufficiently widely disseminated. There seems to be a problem with local authority research in terms of co-ordinating and disseminating it, so that research done in one county can be applied elsewhere.

63. Recently the TRRL has taken a new initiative to increase the effectiveness of transferring the results of research to the private sector and now seeks opportunities for collaboration so that research that has been paid for by government is disseminated widely to the benefit of the private sector. This seems to be

moving in the same direction as the ARRB and prompts the question: what else can we in the UK learn from the way research is organized in Australia?

64. My second point concerns dissemination of research and its implementation. Through the International Road Research Documentation (IRRD) database the UK can draw directly on research going on in Australia and around the world. For example, there is the work of Sweatman on axle weights and heavy vehicle effects on roads in Australia which is directly applicable to the UK. In fact the results of research must be one of the most easily transferred technologies in the world—even though obviously one needs to consider how to apply results in situations far from where they were obtained.

65. At the end of his presentation Dr Metcalf raised the issue of why the people who ought to be using research do not get the information they need. I wonder how many people in this room have used the IRRD database to try to answer an information-related question in the past year; I wonder how many people ought to have done—how many people would have saved themselves both time and money had they done so?

66. My third question relates to the costs and benefits of research. Dr Metcalf was able to cite a set of benefits that far outweighed the cost of the research. Too often researchers who are looking for money to do research are reluctant to make these estimates because they feel the estimates are too imprecise—yet precision is not usually necessary. For example, the skidding standard that was introduced by the Department of Transport earlier this year will save £35 million each year on trunk roads alone in reduced numbers of accidents. In contrast the research done at the TRRL and elsewhere cannot have cost more than £10 million at today's values.

67. If costs and benefits of research are shown to potential customers, good, short term research projects are likely to gain support fairly easily, but what of long term speculative research where end products and benefits are less certain? Is the ARRB confident that in its programme it has enough long term research, or does it have trouble getting the support that is needed to carry on long term research?

Mr M. N. T. Cottell, Kent County Council

Concerning the dissemination of research, the TRRL is about to reintroduce its training courses. I was one of those who benefitted many years ago from the TRRL's training programmes. The best research will not achieve the full payback unless the information is disseminated more effectively than currently. There is no better way of getting research information across—particularly to the younger engineers—than by providing appropriate courses at which they can learn the techniques first hand. My own experience of dealing with managerial change is that people first do not understand even the most simple instructions, and secondly they resist change. Dissemination is something that researchers need to take extremely seriously if the community is to get the maximum benefit from research expenditure.

69. My second point refers to the Author's comments about the research work being closer to the customer. Kent County Council has undertaken two public perception surveys, one which was conducted by Mori and received national publicity. The poll confirmed that the public judge road maintenance as one of the worst services that Kent County Council performed on behalf of the public.

DISCUSSION

The second, done by ERL, says that the public's perception is what the former kind of survey measures, rather than truth.

70. While research should take account of the views and interests of customers (the people who use highways and footways), a research programme should not be slanted entirely in that direction because some of the real payoffs in the future will come from professional and technical people and researchers who think in the medium to long term, rather than look only at the current problem. In defining a programme of research it is important to accommodate both public expectations and technical long term needs.

71. What about the future? From what Dr Metcalf said, his research is gauged towards Australian problems: the major trucks or road trains which go very long distances across Australia. A major problem in the UK is convoys of articulated lorries (supposedly at 38 t maximum weight but actually in excess of that) streaming up the A2 and M2 from Dover to the rest of the UK —so there is a similarity in the UK and Australian experiences.

72. The UK research effort is now aligned more to what the professionals and the public see as major problems: urban congestion, the need to improve the capacity of junctions, and the need to address the problem of road accidents. Perhaps Dr Metcalf is beginning to find pressures of that sort in the urban areas of Australia.

Mr B. Oldridge, AME Chairman

My impressions of the UK is that while the general public has perceptions of what is needed, it is the task of politicians to try to manage these perceptions and translate them into policies. I wonder whether in Australia the same choice of political direction governs the road programme.

Mr K. W. Huddart, Speaker

I was interested in the Author's comments about researchers producing the right sort of lucid text that might be appreciated by others. That points to content and not just to the way in which it is written. The ARRB seem to be doing many things in Australia that in the UK are done by others. For example, the ARRB runs the biennial conference, whereas in this country it would not be run to that extent by the TRRL. Are there other people doing things that are allied to research? In the UK there are many local authorities who carry out work which is more practically based than pure research, and is interpreted by people who think they have a more practical approach to life than the researchers at the ARRB. In Australia, do the states and local authorities do their own work in this way, and how is the ARRB interfaced with them?

75. Australia has greater freedom to get the public to do things than the UK. For example, the UK is still arguing about systematic breath testing, which is miscalled random breath testing. The UK argued for nine years longer than Australia about seat-belt wearing. It would seem that there are other questions of this nature in regard to which you have fewer people to consult, and fewer people who are involved in obstruction.

76. With regard to random breath testing, did it have the sort of benefit in savings that have been rumoured in this country? Very large savings have been suggested in that category of accident.

77. During the summer the Institution, supported by the Department of Trade and Industry, visited the ARRB on a fact-finding mission. They referred to your

red light cameras taking 10 000 pictures, with rumours of considerable reductions in accidents as a result. It was also said that Australia had not made progress on automatic enforcement of the speed limit. This is all associated with the same trend of the public accepting a level of enforcement. Authorities in the UK are having much more difficulty with that at the moment.

Mr E. Flaxman, Binnie & Partner

I was particularly struck by the Australian accident statistics for fatalities, which seem to be about double those in the UK per head of population. My immediate reaction was that it must be because vehicles hurtle along otherwise deserted highways at high speeds. But § 44 of the Paper indicates that 'three-quarters of the fatal accidents occur in urban areas, predominantly at intersections.' That surprised me. My impression of Australian driving is that it is better disciplined than that of the UK and that the observance of speed limits in urban areas is better. I was surprised therefore to read that Australia has so many fatalities at urban intersections, which are spacious in comparison with those in the UK.

79. The Author referred to the ARRB's role in bringing in compulsory seat-belts, and Australia now has compulsory random breath tests. In some states the alcohol limits are lower (50) than they are in others (80, like the UK). Is there any evidence that the lower alcohol reduces accidents?

Professor A. D. May, University of Leeds

With regard to the question of research management, I was involved with the review by the House of Lord's Select Committee on Science and Technology on innovation in surface transport. It looked at some length at the way in which research is managed in the UK. There were two issues that arose on which this discussion has touched.

81. The first is the balance between private sector and government-funded research. Fig. 2 shows clearly that the ARRB is able to attract private sector support. One of the problems that the House of Lords saw with the TRRL—and which has to some extent been overcome with the new Technology Transfer Unit—is the difficulty the TRRL had in taking on private sector supported research because it was not able to increase its research staff complement to tackle that work, and therefore any private sector work had to replace government work. In the case of the ARRB, is it possible to increase staff resources to tackle private sector work, or is it seen as a trade-off? Whatever the outcome, how does the ARRB decide on the balance between private sector and government-funded work?

82. My second question concerns work for other countries, whether in terms of encouraging the sale of Australian expertise or helping the third world. What is the ARRB's approach in deciding how much work to do in other countries and how much work to do in support of the sale of Australian technology?

Mr G. Margesson, formerly TRRL

I should like to take the discussion in another technical direction. I spent several weeks in Australia this summer with the Author, his colleagues and many of his customers and clients. I should like Dr Metcalf to say a little more about the use of CULWAY, the vehicle measuring system that he mentioned briefly. Could the Author say something about the possible extended use of CULWAY, the issues that that raises in terms of control of heavy vehicle traffic particularly, and also the

DISCUSSION

feedback into highway design and structural design. I think there has been some discussion with the commercial vehicle operators in at least one state (Victoria) on how they would approach this question and to what extent they would collaborate. How does the Author see the role of the ARRB in taking this forward, and the research requirements that it might give rise to?

Dr Metcalf

One of the most interesting lessons that all have been learning lately is that the people who pay the money are not necessarily the only customers, they are not necessarily the best informed customers, and they do not necessarily reflect the views of the people who ultimately pay: the motoring public, the road users in the broader sense.

85. The ARRB has had an interesting experience in trying to talk to people other than government road engineers to find out what they perceive as the problem. The ordinary motorist when asked what he wants to see in the road in a physical sense, will tend to talk about such things as skid resistance, being able to see the linemarking, and perhaps having a fairly smooth ride. He certainly talks about not having trenches and pot-holes, and manhole covers sticking up. He will not tend to talk much about finite element analysis and multi-layer systems. Pavement thickness design hardly enters into his mind. When so much emphasis is put on pavement design—the behaviour of materials and the behaviour of motorway pavements—one wonders whether one should try to take a step back to look more at the surface characteristics which are perhaps more important to the ordinary motorist. Perhaps the customer needs to be looked at more broadly to get a better idea of what he wants.

86. With regard to getting across to people the use of the IRRD and other systems, certainly they are the coming thing. Anyone in a technical field ought to be using these sorts of systems. The ARRB is now trying to develop a small database to pick up local area traffic management initiatives. Engineers however don't read. The source of ideas is predominantly discussion with colleagues. The acquisition of literature—formal and informal material—is begged, borrowed or stolen from colleagues. The use of bibliographic services is disappointingly small.

87. The monetary benefits of research given in this Paper were a selection from a study of the ARRB's 25 years of existence, its spending and the benefits accrued. The first figures of benefits were so huge that they were halved—and there was still a benefit: cost ratio of about 14:1. One dollar of research is buying A\$14 worth of benefits. What stopped the implementation and the realization of many of the benefits was, first, getting the message out to people. Even once the message was out, there were the usual bureaucratic or political problems. To give one classic example from Australia, the ARRB has done work on the life of bitumen seal coats which demonstrates that by pre-selecting bitumen of a particular quality it is possible to save money. However, that does not help if the state has a monopoly arrangement with an oil supplier to have an oil refinery built in that state. It does not matter how much research is done, the value will not be felt in less than about 15 years.

88. The balance between short term and long term research is a matter of great concern. The ARRB aims to keep long term research at no less than 30% of the programme. At the moment it is higher than that: but if it drops much below 35% or 30% the ARRB will be in grave danger of losing the expertise that it uses to tackle the shorter term research contracts.

89. In reply to *Mr Cottell*, one of the problems with research workers is that they can easily become intellectually arrogant. They write papers which are intended for research workers, and tend to think that if other people cannot understand them that is their problem. It is a habit that researchers are having to unlearn fairly quickly.

90. Researchers have two peer groups: the academic and the customers who finance them. The pay-off for the research worker is to become internationally known, and he can do that only by producing work that is recognized by his intellectual peers. That is about the only reward he gets. In most cases, his other customer is the taxpayer and he also has to satisfy him. The ARRB tries to do this by being involved heavily in training courses with the state road authorities, and also by having a series of seminars run with local government. The ARRB runs six to eight a year all around the country. Australia is so vast that the ARRB has to deal with particular local authority groups which nominate an area of interest. Those courses are pitched at a level which tries to provide information at the point of application, rather than provide the sort of information that is put in an international technical paper. The organizer has to learn how to write for the audience. It is something that has not been done well certainly by my research group.

91. The change in attitude and direction described by *Mr Porter* is now starting to emerge. Australia does have what is considered in our environment to be urban congestion, and a great deal of effort is made to reduce it. There is also a great concern for safety, but here we have a problem in that, as usual, the public do not like to do the safe things. Australia had compulsory seat-belt wearing very early, in fact, the ARRB did much of the basic research underlying that decision. The UK Minister, Peter Bottomley, came to Australia in 1988 and talked about drink-driving legislation. Certainly Australia has an urban accident problem, but it also has a very acute rural accident problem. About half the fatalities involve single vehicles with a single occupant in a run-off-road accident. That is because there are many people driving long distances in very remote areas, and if they run off the road there is no chance of getting to an emergency telephone or an emergency service. So the accident pattern is rather different.

92. With regard to the influence of politicians and the influence of the public on what the ARRB does, safety has taken a very high profile very suddenly in the past two years, and the ARRB is being called upon to reduce road accidents overnight. But people do not want to obey the speed limit in the residential areas because it slows down the traffic too much. There is now a move to do something about urban arterials, because that is where the problems are showing up.

93. With regard to influencing research, politicians to some extent put the money in different places from those indicated by the research because it is more manageable in the political sense.

94. The ARRB runs its own conference, as *Mr Huddart* said, and that is part of the context of Australia and part of the pattern that developed. There was no outlet for the sort of work that the ARRB was doing in the early 1960s, which were the boom years for road construction, so the ARRB started to run its own conferences to bring out what other people were doing. In Australia the state road authorities were formed between 1913 and 1925. So they had been in business for 40 years by the time the ARRB was established, and had developed considerable technical competence. They spend three times as much on research, in a fairly broad definition, as the ARRB does itself. Local government in general is not

DISCUSSION

organized to do research. At the moment the state authorities pay the ARRB to do it, and are looking very seriously at trying to develop a national way of handling the research needs of local government.

95. As I have already said, when the ARRB started to run its conference there was no other outlet, but now the ARRB has been asked to consider carefully whether it should be running conferences. I believe it should, because it helps those at the ARRB remember that unless they get the information out their research is pointless.

96. The universities have a substantial research programme, but in the highways field it tends to be either very localized short term trouble-shooting type research, or very long term pure research.

97. In response to the question about safety, I cannot give detailed figures from memory but I think that both random breath testing and red lights were claimed to give about 10% savings.

98. The Federal Office of Road Safety spends A\$4 million a year on education and A\$1 million a year on research, and is directly responsible to the Minister. The other road safety research organizations are linked into state transport organizations. In my view they are less independent than the ARRB.

99. The ARRB has just become involved in a study of road accidents in one particular state where it has been asked to suggest initiatives to reduce road accidents. The difficulty is that road accidents are not a very good measure of what happens to the changing behaviour in traffic and, with the small number of accidents in the smaller states, one multiple fatality accident will upset the statistics. Some people would claim such an accident as a total failure, whatever was done, and by others it would be seen as purely a random event.

100. With regard to speed limit auto-enforcement, in Australia radar has taken over completely from any other detection technology. The mandatory penalty system is used. If someone is caught up to 15 km/h over the limit it costs him A\$85, if he is more than 15 km/h over it costs A\$135, if he is 30 km/h over the speed limit—the nationwide speed limit is 100 km—the driver faces a court appearance. Methods such as automated vehicle identification of vehicle number plates have not been introduced.

101. The red light cameras have been picking up some extreme driving behaviour which have resulted in accidents—such as left-hand turns from the outside lane, through the red light. Also, because Australia does not use a starting amber, there are a number of people starting to run the red light on the basis that there is an all-red period of about three seconds.

102. *Mr Flaxman's* impressions of traffic in Australia are the reverse of my own. I think traffic in the UK is better disciplined than in Australia. Certainly people accept smaller gaps here and get away with it. In that subjective area there is not much more that I can say. One of the differences of particular interest is the ratio between total accidents and fatalities. When there is an accident in Australia more people seem to be killed, which reflects the rural accident pattern, with long distances and high speeds, and possibly also high urban speeds.

103. Many Australian cities have a straight grid pattern street system, and where there are wide streets people will build up quite high speeds. I do not know whether they are higher than in the UK or not. Typically, vehicles travel at 75–85 km/h in the morning peak on urban arterials. People expect to be able to do that for fairly long lengths of road, which is not generally the case in Britain. But much of this is, I think, fairly subjective.

104. With regard to drink-driving, the evidence shows that the people who are caught have a blood/alcohol of about 0.12–0.15. Those who have been drinking tend to be at those fairly high levels. However, there is not much data. All the research evidence into human factors points to the need for an even lower limit. Whether it would be socially acceptable is the other side of the question. There is not enough data yet to judge.

105. In response to *Professor May*, research management is a vexed issue on which the ARRB is only feeling its way at the moment. Legally, the ARRB is a private company limited by guarantee. It is not a government organization, and essentially it can do whatever its directors will let it do.

106. In the sense of doing research which is sponsored or funded from outside the states' contributions, the ARRB will do anything it is paid to do, subject to five conditions. First, that the work has some real research content. The ARRB will not do routine testing or routine traffic counts. Second, it should have a national rather than a sectional interest. Third, it should fit within the ARRB's published and public general forward plan for research—the plan that is published every year for review by interested parties. Fourth, it should be done at full cost. The ARRB will not compete with consultants: if a consultant can do it, the ARRB will not do it. Finally, the research must be published within two years. This final condition deters some people: the ARRB will not withhold research from publication.

107. With those conditions—which are a little restrictive if it wanted to be purely commercial—the ARRB can increase its resources. In fact, what has happened to a very large extent is that the ARRB has maintained its research output in spite of reduced funding from government sources over the past ten years. Over the past ten years the ARRB has been getting a budget increase about half that of inflation, so by taking on this sort of sponsored work the ARRB has managed to maintain the research effort. Certainly extra people can be taken on to do the work as and when the work arrives. Some of the work in the trucking area would not be funded by government which at the moment does not regard it as one of their responsibilities. Trucking research has been funded entirely by private industry and the ARRB has increased the resources to do it. The balance between how much contract research the ARRB does and how much is done on core funding from government is the critical question. The ARRB hopes to maintain 30–40% as long term research. Generally speaking it is applied research.

108. With regard to efforts in the third world and the trade versus aid question, anything the ARRB has done in the third world so far has been trade rather than aid. The ARRB is not linked to the government aid programme: any ARRB work is done because the five conditions have been agreed to and the research has been paid for. At the moment the ARRB does about A\$2 million worth of sponsored research, about half of which is in one major contract in China.

109. CULWAY and other weigh-in-motion systems have the technology to measure what is on the highways. There are three pay-offs and three applications. The first is in traffic survey type applications, which is what the ARRB is doing at the moment—using what is on the roads as base data for future prediction, application in pavement design, and so on. The second application is in the enforcement area; and the third is looking at vehicle suspension, cost recovery and all the other things which are related to the amount of damage being done to the road by different classes of traffic.

110. There are about 25 CULWAY systems around in Australia at the

DISCUSSION

moment, collecting traffic data, survey data, speeds, vehicle type and loading. The second application—the first is just going into application at the moment—is in the enforcement field, where a high speed load detection is going to be used. In this particular instance, it will not be a CULWAY system but a surface pad type system (EMU) used on a freeway to allow high speed detection of grossly overloaded vehicles. With a traffic signal system, it will divert the statistically overloaded vehicle into a station where it will be weighed statically and if necessary prosecuted.

111. People have not yet been persuaded that they ought to be able to prosecute on dynamic load data, accepting that there is a statistical risk of being wrong. The first installation of this nature is going in now on a freeway north of Sydney. The configuration is that there is an off-ramp which all heavy vehicles must take, and in doing so they go over the high speed pad. If they are indicated as being overweight, they are faced with a directional arrow which shunts them off into the weigh station, and if not they are shunted back on to the main road without stopping.

112. There is an interesting need behind that which is not really a research need but a research implementation need. Legislation in that state at the moment dictates that vehicles can only be stopped and weighed by a certain official, and that when he stops and weighs the vehicle he must do a number of other things that are not a necessary part of the straightforward load test, such as checking various dimensions and logbooks. Because of that legal requirement, the possibility of using high-speed lanes is prohibited at present.

113. I foresee something that follows the breathalyser legislation for drink-driving in Australia. The original legislation, which was based on blood-alcohol content, got into great difficulties (e.g. with the timing of the testing), and so the legislation was eventually changed to 'exceeding the breathalyser reading'. The same change could be made with weight of load legislation, to make the offence exceeding the reading given by a particular weighing device. This would greatly simplify things.

114. With regard to feedback into design, particularly pavement design, the ARRB has been concentrating some of its efforts at this stage into vehicle design, partly because the commercial vehicle fleet in Australia responds very quickly to changes in vehicle legislation. About 12 years ago a vehicle configuration with two very widespread axles at the rear was outlawed. Within two years the fleet had abandoned that type of vehicle: a very rapid change. A similar thing could happen if suspension legislation could be put in place on that basis.

115. I think that going into pavement design will be a lot slower. At the moment the ARRB is trying to link laboratory tests of materials to behaviour under the accelerated loading facility to behaviour in the field. To get that field data will take a minimum of ten years. We have not yet managed to persuade anyone to grossly under-design a road on a major arterial so that we can get a short term life. I can see the long term implementation of this dynamic weight of load data into pavement design practices, but it is a way down the path yet.

116. The other research need that I foresee is to extend the ability to measure vehicle speed, wheel configuration, vehicle load and vehicle length to an individual vehicle identification system. The driver would pay \$1000 for his licence at the beginning of the year, then if he is not caught speeding, overloading and so on, he would get it all back at the end of the year. Instead of having a penalty built into

the operation there would be a reward for good behaviour. The technology is on the horizon now and one can foresee a need for research into that area.

References

37. DODS J. S. *The ARRB video vehicle detector* ARRB, Melbourne, 1987, ATM 21.
38. BROWN J. I. and PETERS R. J. Development and performance of CULWAY; a culvert based in motion system. *Proc. 14th ARRB Conf.*, 1988, 14, No. 6.
39. TSO Y. *Interim report on articulated vehicle stability phase III full scale dynamic tests*. ARRB, Melbourne, 1987, AIR 323-4.